

AMENDMENTS TO THE CLAIMS

Claims 1-53 (Canceled)

Claim 54 (Currently Amended) A fibrous nanocarbon comprising a plurality of carbon nano-fibrous rods gathered together, wherein each carbon nano-fibrous rod has a central axis and axial end portions, and comprises 2-12 hexagonal carbon layer having a central axis~~layers~~ extending in one direction.

Claim 55 (Currently Amended) The ~~carbon nano-fibrous rod~~ nanocarbon according to claim 54, wherein said hexagonal carbon layers have an axial width (D) of the hexagonal carbon layer is 2.5 ± 0.5 nm, and a length (L) of the hexagonal carbon layer is 17 ± 15 nm.

Claim 56 (Currently Amended) The ~~carbon nano-fibrous rod~~ nanocarbon according to claim 54, wherein said 2 to 12 of the hexagonal carbon layers are stacked in said carbon nano-fibrous rods.

Claim 57 Cancelled.

Claim 58 (Currently Amended) The fibrous nanocarbon according to claim ~~57~~54, wherein the said carbon nano-fibrous rods are stacked in a three-dimensionally close-packed state.

Claim 59 (Currently Amended) The fibrous nanocarbon according to claim ~~57~~54, wherein the said plurality of the carbon nano-fibrous rods are stacked, stacked in a stacking direction with said central axes thereof being parallel to each other, to constitute a carbon nano-fibrous rod cluster.

Claim 60 (Currently Amended) The fibrous nanocarbon according to claim 59, wherein ~~the carbon nano-fibrous rod cluster comprises the said carbon nano-fibrous rods are three-~~

dimensionally stacked, ~~with so as to form nano-gaps being provided between the~~ said carbon nano-fibrous rods ~~rod comprising the 2 to 12 of the hexagonal carbon layers stacked and the carbon nano-fibrous rod comprising the 2 to 12 of the hexagonal carbon layers stacked.~~

Claim 61 (Currently Amended) The fibrous nanocarbon according to claim ~~57~~54, wherein ~~the said carbon nano-fibrous rods are joined in series at said axial end portions to constitute a tubular carbon nano-fibrous rod cluster in an axial direction.~~

Claim 62 (Currently Amended) The fibrous nanocarbon according to claim 61, wherein ~~the~~ said axial end portions of the said carbon nano-fibrous rods are joined by heat treatment.

Claim 63 (Currently Amended) The fibrous nanocarbon according to claim 59, wherein ~~the said carbon nano-fibrous rods constituting said carbon nano-fibrous rod cluster is~~ are arranged at an arrangement angle of larger than 0 degree but smaller than 20 degrees with respect to an axis perpendicular to a fiber axis extending in a said stacking direction of stack of the carbon nano-fibrous rods, thereby forming a columnar shape.

Claim 64 (Currently Amended) The fibrous nanocarbon according to claim 59, wherein ~~the said carbon nano-fibrous rods constituting said carbon nano-fibrous rod cluster is~~ are arranged at an arrangement angle of larger than 20 degrees but smaller than 80 degrees with respect to an axis perpendicular to a fiber axis extending in a said stacking direction of stack of the carbon nano-fibrous rods, thereby forming a feather shape.

Claim 65 (Currently Amended) The fibrous nanocarbon according to claim ~~63~~64, wherein ~~the said carbon nano-fibrous rod cluster has a herringbone structure.~~

Claim 66 (Currently Amended) The fibrous nanocarbon according to claim 63, wherein in said carbon nano-fibrous rods an interplanar distance (d_{002}) between ~~the said 2-12~~ hexagonal

carbon layers is less than 0.500 nm under heat treatment conditions at 700°C or lower.

Claim 67 (Currently Amended) The fibrous nanocarbon according to claim 63, wherein a fiber width of an aggregate of ~~the~~ said carbon nano-fibrous rods is 8 to 500 nm, and a fiber aspect ratio (fiber length/fiber width) of ~~the~~ said aggregate is 10 or more.

Claim 68 (Currently Amended) The fibrous nanocarbon according to claim 61, wherein ~~the~~ said carbon nano-fibrous rods constituting said carbon nano-fibrous rod cluster ~~is-are~~ arranged at an arrangement angle of 80 degrees to 88 degrees with respect to an axis perpendicular to a fiber axis extending in a said stacking direction of stack of the carbon nano-fibrous rods, thereby forming a tubular shape.

Claim 69 (Currently Amended) The fibrous nanocarbon according to claim 68, wherein a fiber width of an aggregate of ~~the~~ said carbon nano-fibrous rods is 8 to 80 nm, and a fiber aspect ratio (fiber length/fiber width) of ~~the~~ said aggregate is 30 or more.

Claim 70 (Currently Amended) The fibrous nanocarbon according to claim 63, wherein a said carbon nano-fibrous rod cluster has a polygonal cross sectional structure in a direction perpendicular to the said fiber axis ~~is polygonal~~.

Claim 71 (Currently Amended) The fibrous nanocarbon according to claim 63, ~~which is heat-treated at a high temperature of 1,600°C or higher, and wherein~~ ends said axial end portions of the said carbon nano-fibrous rods on a surface of the said fibrous nanocarbon are two-dimensionally loop-shaped and three-dimensionally dome-shaped under heat treatment at 1,600 °C or higher.

Claim 72 (Currently Amended) A method for producing fibrous nanocarbon comprising an aggregate of carbon nano-fibrous rods by reacting a carbon material in a high temperature

fluidized bed with ~~use of a catalyst~~, said method comprising using, as a fluid material, a dual-purpose catalyst/fluid material comprising a metal catalyst and a catalyst-supporting carrier bound via a binder, ~~and comprising~~; and performing

- a first gas supply step of supplying a reducing gas,
- a carbon material supply step of supplying the carbon material in a gaseous state to produce a carbon nano-fibrous rod comprising 2 to 12 hexagonal carbon layers extending in one direction, in a presence of the metal catalyst of the dual-purpose catalyst/fluid material, and
- a second gas supply step of supplying a carbon-free gas to eliminate a fluidizing function of the dual-purpose catalyst/fluid material.

Claim 73 (Previously Presented) The method for producing fibrous nanocarbon according to claim 72, wherein an average particle diameter of the dual-purpose catalyst/fluid material is 0.2 to 20 mm.

Claim 74 (Currently Amended) The method for producing fibrous nanocarbon according to claim 72, wherein the dual-purpose catalyst/fluid material comprises a product formed by supporting the metal catalyst on a surface of the carrier, or an agglomerate of the ~~products~~carrier.

Claim 75 (Previously Presented) The method for producing fibrous nanocarbon according to claim 72, wherein the carrier of the dual-purpose catalyst/fluid material is any one of carbon black, alumina, silica, silica sand, and aluminosilicate.

Claim 76 (Previously Presented) The method for producing fibrous nanocarbon according to claim 72, wherein the metal catalyst of the dual-purpose catalyst/fluid material is any one of Fe, Ni, Co, Cu and Mo, or is a mixture of at least two of these metals.

Claim 77 (Previously Presented) The method for producing fibrous nanocarbon according to claim 72, wherein a flow velocity in the fluidized bed is 0.02 to 2 m/s.

Claim 78 (Currently Amended) The method for producing fibrous nanocarbon according to claim 72, further comprising controlling a plurality of conditions for in each of the said first gas supply step, the said carbon material supply step, and the said second gas supply step independently of one another.

Claim 79 (Currently Amended) The method for producing fibrous nanocarbon according to claim 78, wherein the said conditions are a temperature, a pressure, a time, and a gas atmosphere.

Claim 80 (Currently Amended) The method for producing fibrous nanocarbon according to claim 72, ~~further comprising bringing~~ wherein in said carbon material supply step the metal catalyst of the dual-purpose catalyst/fluid material and the carbon material are brought into contact with each other at a temperature of 300 to 1,300°C in a gas mixture of hydrogen and an inert gas (hydrogen partial pressure 0 to 90%) at a pressure of 0.1 to 25 atmospheres, thereby producing the fibrous nanocarbon.

Claim 81 (Currently Amended) The method for producing fibrous nanocarbon according to claim 72, further comprising metallizing and finely dividing the ~~catalytic component~~ metal catalyst of the dual-purpose catalyst/fluid material by a reducing action of the reducing gas in at least one of the said first gas supply step and the said carbon material supply step.

Claim 82 (Currently Amended) The method for producing fibrous nanocarbon according to claim 81, further comprising ~~controlling a particle diameter of~~ finely dividing the metal catalyst of the dual-purpose catalyst/fluid material in finely dividing while controlling a particle diameter of the metal catalyst, thereby controlling a diameter of the fibrous nanocarbon obtained.

Claim 83 (Currently Amended) The method for producing fibrous nanocarbon according to claim 72, wherein the said second gas supply step forms a high velocity flow zone at a high flow

~~velocity locally~~ in the fluidized bed to promote fine division and wear of the dual-purpose catalyst/fluid material by a collision between particles of the dual-purpose catalyst/fluid material, or a collision between the particles and a wall surface of the fluidized bed.

Claim 84 (Currently Amended) The method for producing fibrous nanocarbon according to claim 83, wherein the high velocity flow zone ~~at a high flow velocity~~ in the fluidized bed is formed in a lower portion of the fluidized bed.

Claim 85 (Currently Amended) The method for producing fibrous nanocarbon according to claim 83, wherein the high velocity flow zone ~~at a high flow velocity~~ is formed by flowing a high velocity gas into the fluidized bed.

Claim 86 (Currently Amended) The method for producing fibrous nanocarbon according to claim 85, further comprising supplying particles, which have scattered from the fluidized bed, ~~again~~ back into the fluidized bed while entraining the particles in the high velocity gas.

Claim 87 (Currently Amended) The method for producing fibrous nanocarbon according to claim 72, further comprising separating the ~~produced~~ fibrous nanocarbon from the carrier or the catalyst of the dual-purpose catalyst/fluid material.

Claim 88 (Currently Amended) ~~An apparatus for producing fibrous nanocarbon, which is used in performing the~~ The method for producing fibrous nanocarbon according to claim 72, and wherein the fibrous nanocarbon is produced with an apparatus comprising:

a first fluidized bed reactor charged with the dual-purpose catalyst/fluid material and provided with heating means for heating an interior of the first fluidized bed reactor;

first gas supply means for supplying the reducing gas into the first fluidized bed reactor;

carbon material supply means for supplying the carbon material in a gaseous state into the said first fluidized bed reactor to produce the fibrous nanocarbon comprising an aggregate of

carbon nano-fibrous rods, which each comprise 2 to 12 hexagonal layers extending in one direction;

second gas supply means for supplying the carbon-free gas ~~free from carbon~~ into the first fluidized bed reactor; and

a discharge line for discharging a first gas and ~~scattered particles~~ scattered from the first fluidized bed reactor.

Claim 89 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 88, wherein the apparatus further comprises a recovery means for recovering the scattered particles ~~is provided in the discharge line.~~

Claim 90 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 88, wherein a fluidized bed portion of the first fluidized bed reactor has a high velocity flow portion and a low velocity flow portion.

Claim 91 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 90, wherein the high velocity flow portion includes a collision portion ~~is present in the high velocity flow portion.~~

Claim 92 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 88, further comprising ~~high velocity gas blowing means for blowing a gas at a high velocity into the fluidized bed reactor~~ with a high velocity gas blowing means.

Claim 93 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 92, wherein when the gas is blown at a high velocity, recovered particles are entrained in the gas.

Claim 94 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon

according to claim 88, wherein in said apparatus

a first flow chamber, a second flow chamber, and a third flow chamber, ~~where adapted to allow~~ the fluid material ~~is flowingly movable to flow~~, are ~~formed~~ disposed within the fluidized bed reactor,

the first gas supply means is connected to the first flow ~~chamber~~, chamber;

the carbon material supply means is connected to ~~the said~~ second flow chamber, ~~and~~; and

~~the said~~ second gas supply means is connected to ~~the said~~ third flow chamber.

Claim 95 (Currently Amended) The ~~apparatus method~~ for producing fibrous nanocarbon according to claim 88, wherein the apparatus further comprises:

a first flow chamber and a second flow chamber, ~~where adapted to allow~~ the fluid material ~~is flowingly movable to flow~~, ~~are formed~~ the first and second flow chambers being disposed within the fluidized bed ~~reactor~~, reactor;

~~another~~ a second fluidized bed reactor different from the fluidized bed reactor is provided as a third flow ~~chamber~~, chamber; and

~~transport~~ a transport means for transporting the fluid material from the second flow chamber to the third flow ~~chamber~~ is provided, chamber; wherein

the first gas supply means is connected to the first flow chamber,

the carbon material supply means is connected to the second flow chamber, and

the second gas supply means is connected to the third flow chamber.

Claim 96 (Currently Amended) ~~An apparatus for producing fibrous nanocarbon, which is used in performing the~~ A method for producing fibrous nanocarbon according to claim 72, and wherein the fibrous nanocarbon is produced with an apparatus comprising:

a first fluidized bed reactor having an interior charged ~~interiorly~~ with the dual-purpose catalyst/fluid material, ~~having heating~~ a heating means for heating ~~an~~ the interior of the first fluidized bed reactor, and ~~having first~~ a first gas supply means for supplying the reducing gas into the first fluidized bed reactor;

a second fluidized bed reactor having ~~transport~~ a transport means for transporting the fluid material from the first fluidized bed reactor, and ~~having a~~ carbon material supply means for supplying the carbon material in a gaseous state into the second fluidized bed reactor to produce a fibrous nanocarbon comprising an aggregate of carbon nano-fibrous rods which each comprise 2-12 hexagonal carbon layers extending in on direction;

a third fluidized bed reactor having a transport means for transporting the fluid material and a reaction product from ~~the said~~ second fluidized bed reactor, and having second gas supply means for supplying the carbon-free gas free from carbon into ~~the said~~ third fluidized bed reactor; and

a discharge line for discharging a gas and ~~scattered~~ particles scattered from ~~the said~~ third fluidized bed reactor.

Claim 97 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 96, ~~including~~ wherein the apparatus includes a plurality of the first fluidized bed reactors.

Claim 98 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 96, ~~including~~ wherein the apparatus includes a plurality of the second fluidized bed reactors.

Claim 99 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 96, ~~including~~ wherein the apparatus includes a plurality of the third fluidized bed reactors.

Claim 100 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 88, wherein ~~an average particle diameter of~~ the dual-purpose catalyst/fluid material is has an average particle diameter of 0.2 to 20 mm.

Claim 101 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 88, wherein the dual-purpose catalyst/fluid material comprises a product formed by supporting the catalyst on a surface of the carrier, or an agglomerate of ~~the products~~the carrier.

Claim 102 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 88, wherein the carrier of the dual-purpose catalyst/fluid material is any one of carbon black, alumina, silica, silica sand, and aluminosilicate.

Claim 103 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 88, wherein the metal catalyst of the dual-purpose catalyst/fluid material is ~~any at least one of Fe, Ni, Co, Cu and Mo, or is a mixture of at least two of these metals~~.

Claim 104 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 88, wherein a flow velocity in the fluidized bed reactor is 0.02 to 2 m/s.

Claim 105 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 88, wherein the metal catalyst of the dual-purpose catalyst/fluid material and the carbon material are brought into contact with each other for a certain period of time at a temperature of 300 to 1,300°C in a gas mixture of hydrogen and an inert gas (hydrogen partial pressure 0 to 90%) at a pressure of 0.1 to 25 atmospheres, ~~whereby so as to produce~~ the fibrous nanocarbon ~~is produced~~.

Claim 106 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 96, wherein ~~an average particle diameter of~~ the dual-purpose catalyst/fluid material ~~is~~ has an average particle diameter of 0.2 to 20 mm.

Claim 107 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon

according to claim 96, wherein the dual-purpose catalyst/fluid material comprises a product formed by supporting the catalyst on a surface of the carrier, or an agglomerate of the ~~products~~carrier.

Claim 108 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 96, wherein the carrier of the dual-purpose catalyst/fluid material is any one of carbon black, alumina, silica, silica sand, and aluminosilicate.

Claim 109 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 96, wherein the metal catalyst of the dual-purpose catalyst/fluid material is any one of Fe, Ni, Co, Cu and Mo, or is a mixture of at least two of these metals.

Claim 110 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 96, wherein a flow velocity in the fluidized bed reactors is 0.02 to 2 m/s.

Claim 111 (Currently Amended) The ~~apparatus-method~~ for producing fibrous nanocarbon according to claim 96, wherein the metal catalyst of the dual-purpose catalyst/fluid material and the carbon material are brought into contact with each other for a certain period of time at a temperature of 300 to 1,300°C in a gas mixture of hydrogen and an inert gas (hydrogen partial pressure 0 to 90%) at a pressure of 0.1 to 25 atmospheres, ~~whereby~~ so as to produce the fibrous nanocarbon ~~is produced~~.